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REVIEWS.

Greenland Ice Fields and Life in the North Atlantic, with a New Discussion of the Causes of the Ice Age. By G. FREDERICK WRIGHT, D.D., LL.D., F.G.S.A., author of "The Ice Age in North America," etc., and WARREN UPHAM, A.M., F.G.S.A., late of the Geological Survey of New Hampshire, Minnesota, and the United States. New York: D. Appleton & Company, 1896.

THE contributions of the two authors of this volume are essentially equal, the one having prepared eight and the other seven of its fifteen chapters. The names of both authors appear duly on the title page as above indicated, but only the name of Wright appears on the cover. The book takes its point of departure from the unfortunate Miranda Expedition which, after a series of minor mishaps, met with a decisive disaster off the harbor of Sukkertoppen in South Greenland on the 9th of August, 1894. The senior author was a member of that expedition and spent two weeks on the coast of southern Greenland. The junior author has never visited Greenland. With this scant basis of personal observation it is obvious that the work is essentially a compilation so far as its main theme is concerned. The only original contributions to the ice fields of Greenland are the brief observations of Professor Wright on the local glaciers back of Sukkertoppen. The designation of the glaciers as local is not the author's. On the contrary, Professor Wright ends an enthusiastic description of the principal one visited by him, near Ikamiut, with this climax: "This was verily a part of the inland ice" (p. 94). As a further enforcement of this conception he introduces a map, here reproduced in part (Fig. 1), which represents a tongue of ice flowing along the mountainous divide between the South Isortok and the Kangerdlugsuatsiak fiords in brave negligence of the obstructing peaks and soliciting fiords. It may be interesting to compare this with the accompanying photographic reproduction of the British Admiralty chart (based on the Danish Government Surveys) of

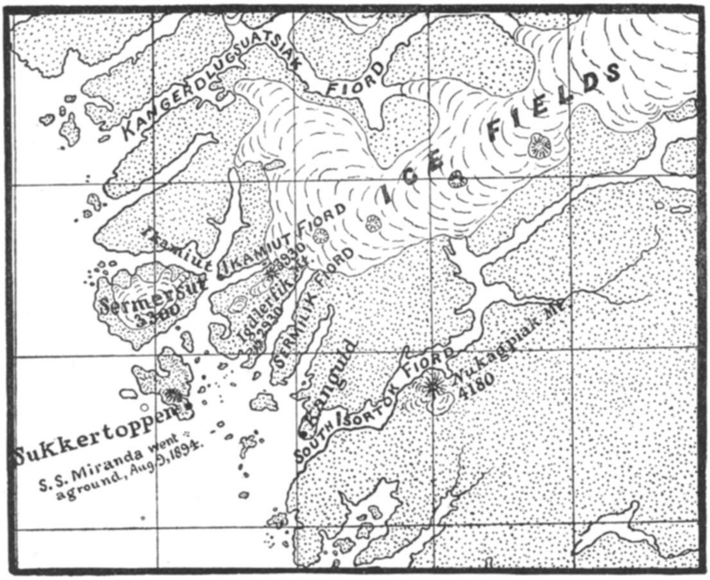

FIG. 1.—Section of the map of the author.

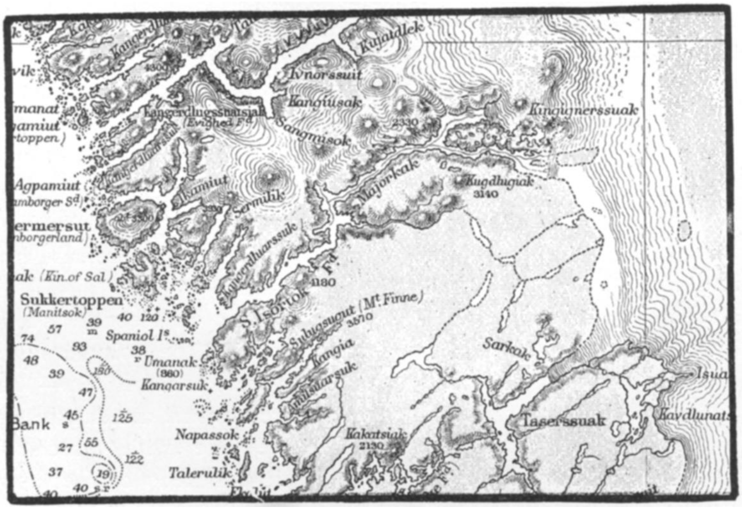

FIG. 2.—Section of the Admiralty Chart.

the same tract (Fig. 2). On it the glaciers appear as the offspring of the snow fields of the mountains that crown the divide and they flow rationally from their local gathering grounds in various directions in due respect to gravitation and the usual habit of glaciers. The glacier near Ikamiut is represented as descending from the snowfield of a neighboring mountain and as finding its source some two-score miles away from the edge of the inland ice which the author nowhere more nearly approached.

Aside from scenic and geographic features, there are two observations of the author that bear on general glaciology: "These glaciers on the south side are all of them thicker near the base of the mountain than in their higher levels. Indeed, they seem to run down like cold tar and to thicken at the base as a stiff semi-fluid would under the action of gravity" (p. 95). "Another phenomenon illustrating the nature of the movement going on in great glaciers was seen here to special advantage. Where the great ice-sheet abutted against the mountain which divided its front into two portions it was pushed up by the momentum of the movement so as to be two or three hundred feet higher at the base of the mountain than it was a mile back. Indeed, a half mile or so back there was a distinct depression in the glacier with the ice higher all around it. It was just such a depression as is made where a current of water is obstructed by some obstacle; the current pushes some distance up the obstruction and then breaks over the sides to go around it; but ice, being much less fluid than water, moves off in larger swells and more gradual curves" (p. 95). A simple computation of the momentum of the glacier and of the ratio of this to basal friction is sufficient to reveal the absurdity of attributing this phenomenon to momentum. There is a special infelicity in citing fluidal action by way of illustration, since it is quite clear that it is the element of *rigidity* in the ice, acted upon by pressure from behind, that produced the upthrust.

Perhaps the observations of Professor Wright on icebergs should be included among the original contributions of the volume to the glacial phenomena of Greenland. Icebergs were encountered—literally in one case—in large numbers and quite unusual dimensions and they are very graphically described. The one with which the Miranda collided is said to have "towered hundreds of feet above us" (p. 6), and another was estimated "to have pinnacles which rose more than 700 feet above the water" (p. 3). In the minds of those who are familiar with the limited depths of the fiords and bays from which the icebergs issue, these towering dimensions will doubtless awaken skepticism, notwithstanding the appeal made in the latter case to an extended base. Professor Wright contributes some interesting observations on the coast of Labrador, accompanied by excellent views.

The chapters written by Professor Wright relate to the *Ice of the Labrador Current*, *The Coast of Labrador*, *Spitzbergen Ice in Davis Strait*, *Excursions on the Coast of Greenland*, *The Coast in Detail*, *The Eskimos of the North Atlantic*, *Europeans in Greenland*, and the *Summary and Conclusion*.

Mr. Upham contributes the chapters on *The Plants of Greenland*, *The Animals of Greenland*, *Explorations of the Inland Ice of Greenland*, *Comparisons of Present and Pleistocene Ice-sheets*, *Pleistocene Changes of Level around the Basin of the North Atlantic*, *The Causes of the Ice Age*, and the *Stages of the Ice Age in North America and Europe*. These chapters contain a large amount of matter brought together from diverse sources and will prove very serviceable to those who have no convenient access to the original literature, or who lack the time to make use of it. The non-geological part of it we must leave to the botanists and zoölogists. The summary of explorations of the inland ice embraces numerous and extended extracts from the writings of the several investigators of the region, knit together by explanatory matter and accompanied by illustrations from Jensen and Chamberlin and a map prepared by the author.

The chapters which relate to the Pleistocene ice-sheet and the causes and stages of the Ice Age are essentially a reproduction, in a revised form, of the author's recent papers on these subjects in various scientific publications and are so familiar to geologists as not to need special review here. Mr. Upham brings out into sharper definition than before his acceptance of the doctrine of notable ice stages. He defines and maps the Warren, Toronto, Iroquois and St. Lawrence stages in addition to the more generally recognized Kansan, Iowan and Wisconsin stages, and applies the nomenclature of the last group to Europe. It is to be observed, however, that the mapping, if not the discrimination, of the four added stages, is almost wholly hypothetical. Mr. Upham still prefers to interpret these stages as phases of a single period of glaciation. The definite recognition of distinct stages, however, removes from the advocacy of the doctrine of "unity" the gravest objection which has heretofore lain against it, viz., neglect of important discriminations and confusion of formations diverse in age and nature. The degree of separation of the glacial stages recognized by Mr. Upham finds its maximum illustration in the retreat of the ice after the Kansan stage for a distance of 500 miles and its readvance about 350 miles, an oscillation which, if applied to Greenland, would eliminate and reproduce its ice-sheet.

Mr. Upham still urges the hypothesis of elevation as the chief cause of the Pleistocene glaciation. It seems not a little infelicitous to urge this doctrine in a work on Greenland, since the testimony of that region weighs heavily against the doctrine. At intervals along a thousand miles of the western coast it was observed by the present writer that a notable part of the mountainous border is rugged and angular and betrays no evidence of ever having been overridden by inland ice. A small driftless area was also discovered on the very border of the inland ice on Bowdoin Bay between latitudes 77° and 78° which shows more unequivocally that there has never been a general extension of the Greenland ice-sheet westward much beyond its present outline. The evidence of former elevation is as pronounced in Greenland as in any part of the northern hemisphere. It appears, therefore, that in this land of glaciers *par excellence*, the former elevation of two or three thousand feet or more was not accompanied by any great extension of glaciation, if indeed it was accompanied by any general glaciation at all. It appears, therefore, that the epeirogenic theory is weak on its most radical point — coincidence of elevation with glaciation — in its most promising region. To the writer it seems unfortunate that the public should be so industriously indoctrinated in a theory of the cause of the Ice Age which encounters such serious and seemingly fatal testimony in the very home of glaciation.

T. C. C.

Ice-Work, Present and Past. By T. G. Bonney. International Scientific Series. New York: D. Appleton & Company.

For the past twenty years the author has written chiefly on petrological subjects. Many of his earlier papers, however, dealt with ice and its work, and this book is an expression of the revival of that